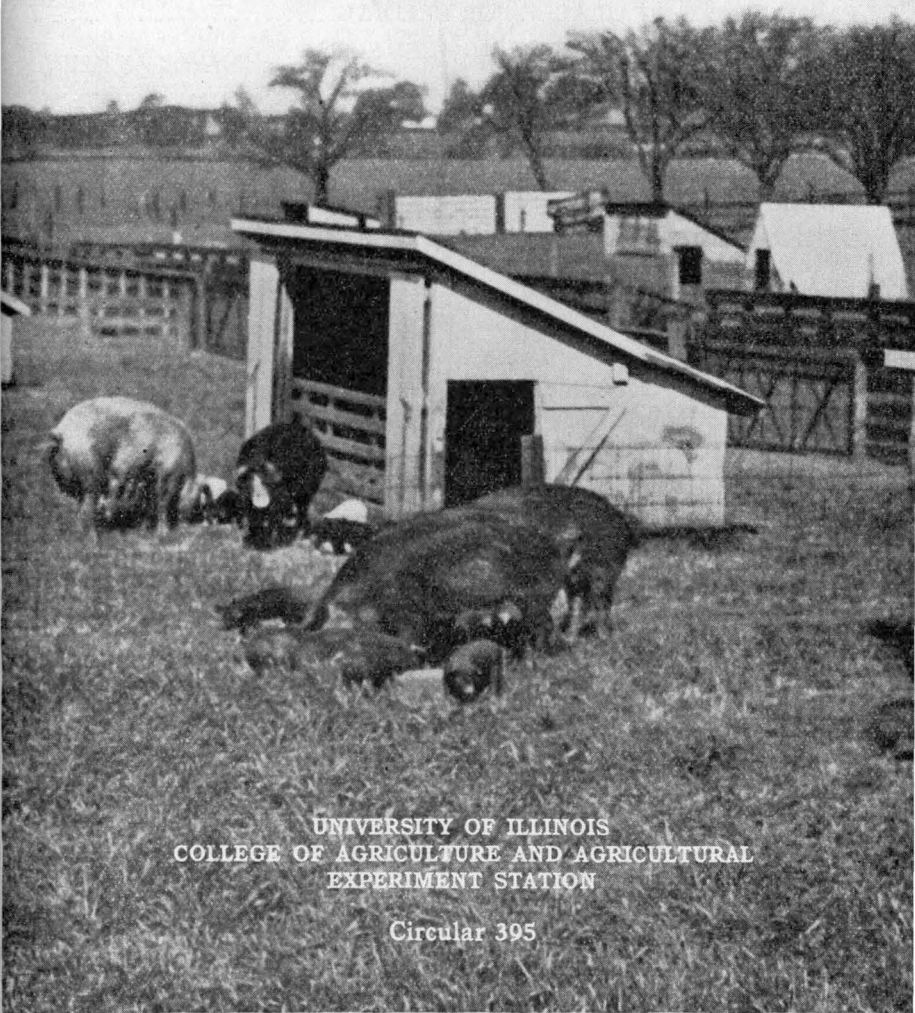


FEEDING HOGS ON ILLINOIS FARMS

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Feeding Hogs on Illinois Farms

By W. E. CARROLL, Chief in Swine Husbandry

THE IMPORTANCE of correct feeding as a factor in economical swine production is indicated by the fact that feed represents so large a proportion of the total cost of producing pork. When corn is worth 60 to 70 cents a bushel, feed represents approximately 85 percent of the total cost. This percentage may drop to around 70 when grains are very cheap and go as high as 90 when they are high in price. The swine grower who expects to make maximum profits from his enterprise must therefore realize the importance of suitable rations and proper methods of feeding.

The feed requirements of swine vary with the purpose for which the animals are kept. Fattening hogs require nutrients in quite different proportion from that best adapted to growing animals, while the requirements of brood sows differ from both of these. The purpose for which the animal is being fed is therefore the primary factor that determines the character of ration to use.

Feeding swine is a unique problem. The relatively small capacity of the digestive tract of swine and their capacity for rapid growth handicap them in utilizing roughages and other feeds of high fiber content. This is especially true of animals that are on full feed, such as fattening pigs and sows that are suckling litters. Even when they are not being fed for high production, swine cannot utilize coarse feeds extensively.

Because of the necessity for limiting their ration largely to concentrated feeds, special precautions must be taken to make sure that the ration fed is complete in all respects. Protein, vitamin carriers, and sometimes minerals must be added to a ration of farm grains if satisfactory results are to be obtained. For a discussion of these subjects see pages 10 and 28.

JUDGING THE VALUE OF FEEDS FOR SWINE

The value of any particular feed in the ration of swine depends on four factors: (1) the chemical composition and digestibility of the feed; (2) the proportion of the ration it makes up; (3) the other components of the ration; and (4) the purpose for which the pigs receiving it are being fed.

Chemical Composition and Digestibility. Swine feeds are primarily of two classes: the farm grains and similar feeds that constitute by far the larger part of the ration; and supplemental feeds that contribute protein, mineral matter, and vitamins that may be lacking or present in inadequate amounts in the basal ration.

The palatability of feeds is an important factor in determining their value under practical conditions, because of the effect it has on the total amount of feed eaten. While the digestible material of most farm grains and many by-product feeds of similar composition does not differ greatly in value for swine, the total amount of such material that an animal can and will consume in a given time from a given feed is an important factor in determining the money value of the feed.

Only concentrates can be used at all extensively in the ration of swine on full feed. Because of this the percentage of fiber in a feed must be given careful consideration in estimating its value for swine. A high percentage of fiber indicates that the feed has a low digestibility and cannot, therefore, be expected to give good results if it makes up any large proportion of the ration. As will be pointed out later, the total fiber content of the ration of mature brood sows during gestation may be as high as 10 or 12 percent. The ration of fattening pigs, however, cannot contain more than possibly 5 percent fiber without reducing the rate of gain.

Of the common farm grains and seeds only oats contain much more than 5 percent fiber (Table 1). Few of the higher grade by-product concentrates carry an excessive amount of fiber. The relatively low feeding value for swine of the roughages, of some by-product feeds, and of oats can be explained by their high fiber content, which ranges from 11 percent in oats to over 30 percent in some of the low-grade roughages. Even the small differences in feeding value between corn and barley can be explained largely on the same basis, tho the relative palatability of these feeds is probably also a factor.

The low protein content of common farm grains, that enter so largely into swine feeding, places a premium on high-protein concentrates with which to supplement them. For best results, swine rations, as is shown later, should contain possibly from 10 to 18 percent protein. The common farm grains that are used most extensively in swine feeding, on the other hand, contain only 9 to 13 percent protein.

The source from which the supplementary protein is obtained is also of some importance. In general, high-protein feeds of animal origin, such as skim milk, buttermilk, tankage, and fish meal, have a higher supplementing value than proteins from vegetable sources, such as by-products of the milling industry, oil meals, and gluten meals.

TABLE 1.—PERCENTAGE COMPOSITION OF SOME COMMON SWINE FEEDS¹

	Water	Ash	Total protein	Fiber	N-free extract	Ether extract (fat)	Number of analyses
Corn.....	14.5	1.4	8.6	2.6	69.7	3.2	80
Barley.....	13.0	2.4	11.7	5.8	65.5	1.7	2
Wheat.....	12.5	1.8	11.9	2.8	69.5	1.5	2
Oats.....	10.1	4.0	10.4	11.4	59.2	4.8	22
Oat kernel ²	10.1	2.1	13.8	1.4	64.8	7.8	179
Rye ³	9.4	2.0	11.8	1.8	73.2	1.8	108
Wheat middlings....	10.8	3.7	17.0	4.6	59.0	4.7	5
Wheat bran.....	9.5	6.8	15.1	10.7	54.4	4.2	7
Buttermilk ³	90.6	.7	3.6	...	5.0	.1	...
Skim milk ³	90.1	.7	3.8	...	5.2	.2	...
Dried buttermilk ³ ...	4.5	8.1	34.6	...	50.9	1.9	7
Semisolid buttermilk ³	65.0	2.7	13.4	...	15.9	3.0	...
Whey ³	93.4	.7	.8	...	4.8	.3	...
Tankage.....	8.1	19.7	60.0	1.5	2.2	8.5	9
Fish Meal ³	10.5	28.1	51.4	...	...	8.3	13
Linseed meal.....	9.5	5.7	34.8	8.7	36.2	5.5	33
Soybean oil meal....	10.0	6.0	41.6	6.4	30.7	5.5	21
Soybeans.....	11.2	4.8	37.1	8.4	22.2	17.1	19
Cottonseed meal....	8.0	6.6	42.8	9.2	26.2	7.2	2
Alfalfa hay.....	9.7	7.8	15.4	27.2	37.8	2.1	77
Red clover hay ⁴	12.9	7.1	12.8	25.5	38.7	3.1	...
Soybean hay ⁴	18.1	9.1	11.2	26.2	32.7	2.6	...

¹Except when otherwise indicated, these analyses were made in the Animal Nutrition laboratory of this Station and therefore represent the composition of feeds available to Illinois feeders. ²Computed from data given in "Feeds and Feeding," Henry and Morrison, 18th ed. ³From "Feeds and Feeding," Henry and Morrison, 18th ed. ⁴"Utilizing the Soybean Crop in Livestock Feeding," Illinois Station Circ. 369. 1931.

Feeds of high mineral and vitamin content are of more importance in dry-lot rations than when the feeding is being done on pasture. The dozen or more mineral elements that are essential to animal life are present to some extent in all common feeds. Plants usually store a smaller percentage of calcium in their seeds than in their leaves and stems. For this reason rations that are composed entirely of grains and seeds, as is not unusual with swine rations, are deficient in calcium as well as in common salt. Suitable feeds that are rich in these minerals, if added to mineral-deficient rations, may at times bring about remarkable improvement in the ration. Most protein supplements of animal origin contain liberal amounts of calcium, and some, like tankage, are also rich in salt. Practically all seeds and grains are rich in phosphorus and the other essential minerals except calcium and salt. Pasture, especially if it is leguminous, supplies an abundance of

minerals with the exception of salt. The addition of leguminous hay of good quality to dry-lot rations likewise goes far toward correcting mineral deficiencies.

It may be advisable under certain conditions to select feeds because of their vitamin content. Vitamins A and D are the ones most likely to need attention in practical swine feeding. Yellow corn is rich in the A factor tho it does not carry D. The other common farm grains and seeds carry neither A nor D. Pigs on pasture seldom suffer for lack of these factors and the addition of 2 to 5 percent of leguminous hay of good quality to dry-lot rations takes care of these requirements reasonably well. Fish meal is the only other common swine feed that carries appreciable amounts of vitamin D.

Proportion of Feed in Ration. The extent to which a feed is fed may affect its value. The value of certain feeds of high fiber content, such as oats, and those of laxative nature, such as linseed meal, decreases as the proportion they make of the ration increases. Supplementary feeds also are less valuable per unit fed as the proportion in the ration increases. For example, as a supplement to corn skim milk has a higher value per 100 pounds when it is fed in the proportion of 2 pounds of milk to 1 of corn than when 7 pounds of milk are fed with each pound of corn. This does not mean, however, that liberal amounts of a supplement may not be profitable. A ration that contains enough protein supplement to balance it will usually be more profitable than one that supplies too little protein.

Relation to Other Feeds. The value of a feed is influenced by the other components of the ration. Greater benefit can be expected from adding a feed rich in protein to a ration low in this nutrient than to a ration that already contains a liberal amount of protein. It is equally true that a feed of high fiber content (oats) might replace a third or even half of the corn in a ration of corn and tankage without greatly reducing the efficiency of the ration. A similar substitution of oats for corn in a ration of corn and alfalfa hay 5:1 would, however, increase the fiber content of the ration much beyond the capacity of hogs to handle it effectively.

The value of many feeds in swine rations is thus dependent on the other constituents of the ration.

Purpose of Feeding. The purpose for which pigs are being fed also influences the value of certain feeds. Protein supplements added to a ration of farm grains save much more grain when used in the ration of full-fed pigs than they do if fed to pigs that are gaining at a slower rate. Protein supplements are also more important for young pigs and lactating sows than for dry sows. In this connection mention

has already been made of the fact that feeds of high fiber content are less of a handicap in the ration of mature dry sows and shoters on light feed than they are in the ration of milking sows and fattening pigs on full feed.

FARM GRAINS AVAILABLE FOR FEEDING

Swine are kept on the farms of this country primarily as a means of marketing the surplus grain produced. While there is a large number of hogs fed principally on garbage and other by-product materials, the rations of most swine are made up largely of farm grains. It is important, therefore, to know the characteristics of the different available grains in order that they may be used most profitably. A knowledge of the principles discussed in the preceding section should aid the swine feeder materially in understanding the comparative values of the available feeds if he is acquainted with the characteristics of the feeds.

Corn. The extensive production of corn in the Mississippi valley is largely responsible for the large number of swine in this region. Corn is very palatable to all classes of swine, is low in fiber, and when fed intelligently, is very productive. While its protein and mineral content are both low in amount and unbalanced in composition for swine, these deficiencies when once understood are easily corrected (see page 10).

By adding a suitable protein supplement, such as skim milk, buttermilk, tankage, or supplementary mixtures that are rich in tankage, to a corn ration and providing pasture or alfalfa hay, the nutrients are supplied that corn lacks. The combination of corn with such supplements makes an excellent ration. Yellow corn contains enough vitamin A to meet the needs of swine, tho white corn is deficient in this essential. When white corn is fed on pasture or in connection with good legume hay, this deficiency never becomes a limiting factor in swine feeding.

Corn is very easy to feed. Because of its large, relatively soft kernel it needs no special preparation for hogs, and even the cost of harvesting can be saved by "hogging" the crop down when fall rains are not so heavy as to make the field too muddy.

Barley. In sections of the country that are too cool for corn to thrive, barley is the principal feed grain produced. In composition barley is very similar to corn, tho it is less palatable to most classes of livestock. It contains somewhat more protein, ash, and fiber than corn and somewhat less carbohydrates and fat. The fiber content of

good barley is not high enough to interfere with its value as a feed for swine.

Since barley is a cool-weather crop, the best grades are grown in the northern section of the country and in the higher western states where cool nights are the rule. Barley grown in the warmer sections of the country is not so plump as northern-grown barley and as a result carries a larger proportion of hull and more undigestible fiber.

Barley that is heavily infested with scab (*Gibberella saubinetii*) is very unpalatable and even dangerous to pigs.

Sound barley can be used in swine feeding as a partial or complete substitute for corn. It is not so easily fed as corn, since for best results it should be coarsely ground or rolled. The kernels are so small and flinty that the pig in his hurried eating fails to crack a large number of them. The kernels that are not cracked pass thru the animal unutilized. A saving of 15 to 20 percent of the barley may be expected from grinding or rolling it (pages 29 and 30). Soaking is a poor substitute for grinding, in this case, as it saves little if any feed.

Plump, well-filled barley of good quality, if rolled or coarsely ground, has a feeding value for pigs within 5 to 10 percent of that of corn, while the feeding value of light-weight, chaffy barley may be only two-thirds to three-fourths that of corn per pound. Many experiments are on record in which good barley proved fully equal to corn for fattening hogs.

Wheat. The price of wheat is usually so high as to curtail its use in livestock feeding. Wheat damaged by frost, insects, disease, or fire can be utilized successfully in swine rations.

Wheat is very palatable to hogs. For best results it should be coarsely ground or rolled. As in the case of barley, this process may save 15 to 20 percent of the grain (pages 29 and 30). Fine grinding should be avoided, as the resulting floury particles form an objectionable, sticky mass in the mouth of the pig.

The chief difference in the composition of wheat and corn is the higher protein and lower fat content of the wheat. Wheat can be used as a partial or complete substitute for corn in any swine ration. Replacing part or all of the corn in the ration of fattening hogs with coarsely ground or rolled wheat usually results in slightly more rapid gains and a saving of approximately 5 percent in feed.

Because of the higher protein content of wheat less protein supplement is required to balance rations containing it than to balance rations of corn.

Oats fit so well into Illinois cropping systems that many farm-

ers have been loath to give them up in spite of poor market demand. The decline in the number of horses (the chief consumers of oats) in the United States during recent years has left more oats to be utilized by other livestock.

As a feed for hogs oats are definitely handicapped by the fibrous, indigestible hull that makes up approximately 28 to 35 percent of their weight. They contain more protein and ash, tho very much less digestible carbohydrates than corn. Oats that contain a high percentage of kernel are definitely more valuable for hogs than oats that contain relatively little kernel. While weight per bushel does not indicate infallibly the amount of kernel in oats, heavy oats do in general contain more kernel than light-weight oats.

The amount of oats to feed to hogs depends chiefly upon the relative price of corn (or other grains) and oats, the class of hogs to which they are fed, and the method of preparing them. If fed as the only grain to hogs, oats are worth from half to three-fourths as much as corn per pound, not considering the much slower gains they make. Fed in amounts not to exceed one-fourth to one-third of the ration their value may be 75 to 90 percent that of corn.

In general, sows during gestation and stock hogs that are not on full feed utilize oats to better advantage than other classes of swine. For these animals oats of good quality may be worth nearly as much as corn.

It is the hulls of oats that make them unpalatable to pigs. Any preparation that makes the hulls less noticeable increases palatability. Coarsely ground oats are more palatable than whole oats, finely ground oats are more palatable still, and hulled oats are most palatable of all.

Recent tests in which whole and ground oats (mostly finely ground) have been compared as a part of the ration of fattening pigs indicate that when oats constitute one-fourth to one-third of the ration, grinding 100 pounds of oats saves from 25 to 30 pounds of feed. In some cases the saving was due to slightly more rapid gains, but mostly to differences in feed consumption or feed waste, there being noticeably more waste in feeding whole oats.

Oat kernels of course have a higher feeding value per pound than whole oats, but the difference usually is not enough to cover the cost of hulling and the value of the oats lost in the hulling operation.

The growing of a variety of oats that thresh a naked kernel is one solution of the oats problem for hogs.

Rye is grown and fed less extensively in the United States than the other major farm grains. In composition rye resembles wheat

rather than corn or barley. It is less palatable than the other grains and therefore can best be used as a part of the ration and for short feeding periods. Its kernels are even smaller and harder than those of the other grains, which suggests that rye should always be ground for swine.

Experiments indicate that ground rye of good quality may be worth from 90 to 95 percent as much as an equal weight of corn for fattening hogs.

IMPORTANCE OF PROTEIN SUPPLEMENTS

Protein is most frequently the limiting factor in the ration of swine. This is due to the fact that the common farm grains and many of the by-products that are available carry too low a percentage of protein for best results in the rations of most classes of swine. Not only is the amount of protein from these sources inadequate, but its quality is not well suited to the needs of swine. For this same reason mature seeds (such as beans, peas, and soybeans) and many by-products of the milling, starch, and oil industries (such as cottonseed meal, linseed meal, soybean oil meal, corn germ oil meal, and gluten meal) that contain sufficient amounts of protein are unsatisfactory when used as the only supplements to common farm grains. The protein of these feeds of vegetable origin does not in general supplement the protein of the farm grains well, and a ration composed of farm grains and such by-products is still lacking in certain mineral elements, principally calcium and common salt. Some of these feeds are also unpalatable to pigs.

Experiments Show Value

Experiments on the question indicate without exception that the common farm grains are much improved for swine by the addition of protein supplements. Such supplements greatly stimulate the appetite, which is reflected in a much larger feed intake. The heavier and better balanced ration, in turn, increases the rate of gain and reduces the feed required for each unit of gain. The extent of this improvement depends on the age of the pig and the feeds being fed. Young pigs suffer more than older ones from insufficient or unsuitable protein in the ration; and a protein supplement fed in dry lot returns much more in added gains and in feed saved than it will if fed to similar pigs on pasture.

Summaries showing the rate of gain and feed requirements of similar pigs fed corn with and without tankage are presented in Table 2. Figures for tankage were used in this table because such complete

TABLE 2.—VALUE OF TANKAGE AS A SUPPLEMENT TO CORN FOR FATTENING PIGS¹

	Light pigs in dry lot		Heavy pigs in dry lot		Light pigs on pasture	
	Corn	Corn and tankage	Corn	Corn and tankage	Corn	Corn and tankage
Number of tests.....	6	6	8	8	9	9
Total pigs.....	24	29	69	69	77	79
Average days in test.....	102	102	84	84	113	110
Average initial weight....	63	62	132	134	52	52
Average final weight.....	116	186	223	267	161	199
Average daily gain.....	.54	1.16	1.04	1.56	.97	1.34
Average daily ration						
Corn.....	3.10	3.80	5.63	6.35	3.96	4.63
Tankage.....	....	.40	....	.54	....	.27
Feed for 100 pounds gain						
Corn.....	581	350	537	410	409	345
Tankage.....	....	36	....	34	....	20
Corn saved by 100 pounds tankage.....	....	642	....	374	....	320

¹This summary includes twelve tests from the Ohio Station, three from Kansas, two each from Nebraska and Michigan, and one each from Indiana, Iowa, Alabama, and Mississippi.

data are not available for other supplements. Any suitable protein supplements, however, would be expected to give similar results. The gains of the light pigs when fed only corn in dry lot were so slow as to be extremely expensive. A matter of equal importance under practical conditions is the fact that a large number of pigs thus fed become unthrifty and many of them actually die. The rate of gain also governs the time required for the pigs to reach market weight, which is a factor in the risk involved and the promptness of turnover of working capital. In this connection also must be considered the season at which the rapid- and the slow-gaining pigs will be ready for market and the probable market value of each under those conditions.

The difference in rate of gain shown in the table between the pigs fed only corn and those fed corn and tankage are exaggerated somewhat because of the heavier final weights reached by the tankage-fed pigs, since final weight influences the figure for rate of gain. Comparisons are not available in which the two groups were carried to the same final weight. This does not modify the fact, however, that 62-pound pigs fed corn and tankage in dry lot gained 124 pounds during

the time that similar pigs fed only corn were gaining but 53 pounds. The gains of the heavier pigs in dry lot were 91 pounds on the corn ration and 133 pounds on corn and tankage, while on pasture the two rations produced 109 and 147 pounds of gain respectively on 52-pound pigs.

Disregarding the value of rapidity of gain, tho it is an extremely important practical consideration, each pound of tankage eaten by the lighter pigs in dry lot had the value of 6.42 pounds of corn because the 36 pounds of supplement eaten for each 100 pounds of gain saved 231 pounds of corn. Heavy pigs that had passed the period of their greatest need for protein also responded to the addition of tankage. Their rate of increase in gain and the amount of feed saved were lower than in the case of the lighter pigs, but were still significant, since 100 pounds of the supplement saved 374 pounds of corn. Even on good pasture the addition of tankage stimulated the gain of the pigs and saved feed. Disregarding the difference in rate of gain, 100 pounds of supplement saved 320 pounds of corn.

Supplements of Animal Origin Generally Best

In practice certain high-protein feeds are found to be more valuable than others as supplements to the farm grains. This may be due to differences in the quality of protein they carry, to differences in the amount or nature of their minerals, or even to their palatability.

Available space will not permit a separate discussion of all the feeding materials that might be used as supplements to farm grains. As a general rule supplements of animal origin, such as dairy by-products, tankage, and fish meal, have a higher supplementing value than materials of plant nature, such as the oil meals, gluten meals, and other cereal by-products.

A comparison of a few of the more important protein supplements for swine is given in the following paragraphs.

Skim Milk and Buttermilk. In supplementary value skim milk and buttermilk excel any other single feed. They are especially recommended for pigs just after weaning. They are very palatable and digestible; they contain between 3 and 4 percent of protein, which supplements well the protein of farm grains, and they are rich in essential mineral elements.

Skim milk and buttermilk are equally valuable for hogs, tho in the purchase of buttermilk precautions should be taken to see that it has not been diluted by the wash water. Both products should be pasteurized in order to prevent the spread of tuberculosis and possibly contagious abortion in the swine.

The principal handicap to the wider use of these dairy by-products in swine feeding is the insufficient supply available and their bulk, which practically prohibits moving them from areas of surplus production.

The high value of these products is shown by the fact that 100 pounds of skim milk, which contains on the average less than 10 pounds of dry substance, has in feeding tests replaced over 15 pounds of dry matter in a corn and tankage ration. Skim milk is somewhat more valuable than tankage for young pigs tho the difference tends to disappear as the pigs approach market weight. Roughly, 100 pounds of these dairy by-products can be considered worth half as much as a bushel of corn.

The amount of milk to feed for greatest returns will, of course, depend on the relative prices of feeds. When skim milk is fed in small amounts it has a higher value per pound than when it makes up a large proportion of the ration. It usually pays to feed enough skim milk or buttermilk to balance the ration. Young animals require a larger proportion of milk to grain than older animals do. They, however, eat less total feed in a day. When allowance is made for both these factors it is found that about one gallon of skim milk or buttermilk per head daily will balance the corn ration of full-fed pigs from weaning to market weight. During the period of rapid growth between weights of 90 and 130 pounds, $1\frac{1}{2}$ gallons of milk will be needed.

Other milk products that are used more or less extensively in swine feeding are whey, semisolid buttermilk, and milk powder.

Whey. Since the protein of milk is largely removed in the cheese-making process, whey is not rich in this nutrient. It contains about .8 percent. The average of a number of feeding trials gives whey a value equal to about half that of skim milk. For light pigs whey is considerably less valuable than this because the pigs require more protein than is contained in a ration of corn and whey. Pigs that weigh over 100 pounds, on the other hand, may make excellent gains on such a ration. Because of its bulk, whey must be fed close to where it is produced.

Semisolid Buttermilk. This is the regular creamery buttermilk condensed to about one-third its volume by the removal of a portion of the water by evaporation. The product is a soft, cheese-like mass that contains on the average 65 percent water, 13 percent protein, 2.7 percent ash, 3 percent fat, and about 16 percent carbohydrate material, which is largely milk sugar. Semisolid buttermilk is palatable to most pigs and makes an excellent supplement to corn. Its price, however,

is usually greatly out of line when its productive value is compared with other available supplements.

Feeding trials in which semisolid buttermilk has been compared with tankage as a supplement to corn indicate that on the average the buttermilk is worth only about one-third as much as an equal weight of tankage. This is roughly in proportion to the amount of protein the two feeds carry. Semisolid buttermilk is somewhat more valuable in proportion to tankage for young pigs than for those of heavier weight. On pasture its value is lower in relation to the value of tankage than it is in dry lot.

Small amounts of semisolid buttermilk fed with other protein supplements may have a somewhat higher value than this, tho even under these conditions its value in the ration is much below its price, which is usually considerably above the price of tankage.

Milk Powder. Dried milk, made either from skim milk or buttermilk, contains about 36 percent protein. Like semisolid buttermilk, it is an excellent feed, but its price is usually much too high to make its use in swine rations profitable. The rather limited study that has been given this feed suggests that its value in a ration is about three-fourths that of an equal weight of tankage.

Tankage. A by-product of the packing industry, tankage is the most widely used high-protein supplement that is now fed to hogs. High-grade tankage contains 60 percent protein and 15 percent mineral matter both of which are utilized well by hogs. Results of well-controlled determinations indicate that the protein of tankage is digested to the extent of 76 percent by pigs.¹

The amount of tankage to feed under given conditions will have to be computed from feed compositions and the requirements of the animals being studied. Full, corn-fed, fattening pigs in dry lot will require from .4 pound per head daily, when they weigh 30 to 50 pounds, to .75 pound during their rapid growth at a weight of 90 to 130 pounds. Their requirements decrease to .3 to .4 pound as they approach a weight of 200 pounds. Approximately half these amounts will be sufficient on good pasture.

The characteristics of tankage are such that full-fed pigs eat about the right amount to balance a corn ration where the two feeds are offered free-choice. When small grains are used in place of corn (particularly barley, rye, and oats) or in case the corn is of poor quality, pigs frequently eat more tankage, if it is available at all times, than is required to balance their ration. This condition can, of course,

¹From Department of Animal Husbandry, University of Illinois, by courtesy of Dr. H. H. Mitchell.

be controlled by hand-feeding the tankage. The tankage consumption of pigs on good pasture may also need to be watched.

For dry-lot feeding, tankage can be improved, as shown in the next paragraph, by mixing with it alfalfa meal and certain of the oil meals.

Mixed Supplement. As soon as the shortcomings of tankage as a supplement to corn came to be understood, efforts were made by investigators to discover a supplement that would give better results. The Wisconsin Experiment Station, after the completion of ten carefully controlled experiments, announced a supplement that is superior to tankage. It is composed of 2 parts by weight of tankage and 1 part each of linseed meal and alfalfa meal or chopped alfalfa hay. The authors report comparisons of this supplement "not alone with the standard ration of corn and tankage, but also with the ideal combination of yellow corn and skim milk. Young pigs have been taken right from their mothers in the fall and put on these rations at 8 to 9 weeks of age. To our amazement the pigs given the combination of corn, tankage, alfalfa and linseed meal, without pasture and with no dairy by-products whatsoever after weaning time, have excelled in gains the pigs fed yellow corn and skim milk. The same results have been secured in repeated trials."

Since this startling announcement (about 1923) attempts have been made at several stations to find something superior even to this mixture. To date, however, these attempts have been unsuccessful. The mixture contains approximately 42 percent protein of good quality and is rich in minerals and vitamins. It is suitable for feeding all classes of swine in dry lot and is palatable enough that it can be fed free-choice with corn to animals on full feed. Its wide use is encouraged by its simplicity and by the fact that under average price conditions it is not only more effective than tankage but cheaper as well.

Until future work suggests some improvement, this mixture can be looked upon as the best protein supplement that is generally available for dry-lot feeding, especially of young pigs. When feeding is being done on pasture, the alfalfa is omitted from the mixture.

When prices of feeds or their availability make it desirable, certain substitutions can be made that do not materially affect the feeding value of the mixture. For example, soybean oil meal is apparently just as good in the mixture as linseed meal. Even cottonseed meal has replaced the linseed meal without interfering greatly with the value of the mixture. Clover or soybean hay, if of good quality, can apparently replace the alfalfa hay, and fish meal may be substituted for the tankage. Thus a knowledge of the characteristics of the various

feeds that may be used makes it possible to reduce the cost of the mixture without lowering the actual feeding value.

Fish Meal. When of good quality, fish meal has proved in feeding tests to be somewhat superior to tankage as a supplement to corn. It contains over 50 percent protein and about 28 percent mineral matter, both of which supplement the deficiencies of farm grains in these nutrients. Wherever its price will permit, therefore, it can be substituted for tankage in swine rations.

Soybeans. A source of home-grown protein that can be used in a limited way in swine feeding is provided by soybeans. They contain about 36 percent protein, 5 percent ash, and 17 percent oil. The beans are not palatable to pigs and their protein and ash do not supplement the common farm grains well. If the beans are fed in sufficient amounts to balance a ration of corn for fattening hogs (about 20 percent), the oil of the beans causes a soft, flabby, unattractive condition in the resulting carcass and produces lard of a semiliquid, greasy appearance. These products must sell at a lower price on the market, which reacts on the price of live hogs suspected of having been fed on soybeans (see page 32).

Soybeans can, however, be fed to brood sows as a protein supplement to farm grains. About three-fourths of a pound a day for each sow is sufficient during gestation. This should be increased to a pound or more during the suckling period.

Because of the mineral deficiencies of soybeans, animals whose rations are supplemented with them should be allowed access to a suitable mineral mixture (see page 28). Grinding the beans is unnecessary and is even detrimental in warm weather, because the oil thus exposed to the air and bacterial action becomes rancid, making the beans unpalatable.¹

Soybean Oil Meal. The high oil content of soybeans that gives them their value in commerce is an actual handicap to their value as a feed for swine. The residue resulting from the removal of the oil, known as soybean oil meal, is therefore a better hog feed than the original beans. The oil meal contains approximately 42 percent protein and 6 percent ash. As a supplement to corn, soybean oil meal has about two-thirds the value of tankage per pound. It is more palatable than the original beans and is not detrimental to the quality of pork and lard produced. Like the beans, it should be fed with a suitable mineral mixture (see page 28). Soybean oil meal apparently gives as

¹For a fuller discussion of the feeding value of soybeans and soybean oil meal see Circular 369 of this Station, "Utilizing the Soybean Crop in Livestock Feeding."

good results as linseed meal in mixtures with tankage or tankage and alfalfa hay.

Linseed Meal. This feed, containing approximately 34 percent protein, is used to a considerable extent in swine feeding. Compared with tankage, especially for young pigs in dry lot, it has little to recommend it, tho it is better than no supplement. For pigs weighing over 125 pounds and when fed in connection with pasture, it has shown a value one-half to three-fourths that of tankage. Its value is higher when it is mixed with tankage and alfalfa meal (see page 15).

The laxative properties of linseed meal make it a valuable addition to the ration of sows at farrowing time, tho its careless or too extensive use at that time may result in the development of scours in the little pigs. One-fourth or even one-third of a pound of the meal may be fed to each sow daily if care is exercised.

Cottonseed Meal. The different grades of cottonseed meal contain from 38 to 43 percent protein. Its use in swine feeding has been limited by the fact that occasionally it has caused the death of pigs, apparently from poisoning. Recent studies indicate that in rations that supply enough of the right kind of minerals and vitamins cottonseed meal can be used to furnish from 40 to 60 percent of the protein needed to "balance" farm grains for fattening pigs and even a higher proportion in the ration of brood sows. Rations that contain as much as 9 percent of cottonseed meal have been fed extensively without loss at the Texas station.¹

Cottonseed meal cannot safely be fed free-choice with farm grains. Mixtures of equal parts of cottonseed meal and tankage have been thus fed without loss. In many cases the gains on the mixture have been more rapid than when only tankage was fed as the supplement. Cottonseed meal has been used successfully in mixed supplements in place of linseed meal (see page 15).

Wheat Middlings or Shorts. Tho fed extensively to swine, the value of wheat middlings or shorts as a supplement in the ration is frequently overrated. A summary of a number of experimental tests indicates that 100 pounds of middlings may replace from 6 pounds of tankage and 74 pounds of corn to 11 pounds of tankage and 108 pounds of corn in the ration of fattening pigs. In these tests middlings proved to be less valuable for light pigs than they were for those of heavier weights.

Cost and Conditions Govern Choice. There is no simple method of determining without trial which of several supplements will give

¹"Cottonseed Meal as a Feed for Hogs," Texas Agr. Exp. Sta. Bul. 410.

the best results under given conditions. The general superiority of supplements of animal origin over those from plant sources should be kept in mind.

Protein is primarily the nutrient that must be purchased by swine growers, because the crops they produce on their farms supply the other materials needed. The problem then resolves itself into buying protein of satisfactory quality where it can be purchased most cheaply.

Suppose, for example, that one has the opportunity to buy a supplemental feed the general composition of which seems to be satisfactory. The feed sells for \$2 a hundred pounds and is guaranteed to contain 30 percent protein. Suppose further that 60 percent protein tankage is available at \$3 a hundred. By simply dividing the cost of 100 pounds of the feed by the percentage of protein it carries, it is clear that the first feed supplies protein at $6\frac{2}{3}$ cents a pound, while in the tankage a pound of protein costs only 5 cents.

This computation purposely disregards the carbohydrates of the supplements, not because they have no feeding value but because the carbohydrates in such feeds are no more valuable than the carbohydrate material which is so abundant in all farm grains at a much lower cost.

While the problem is not so simple as this example suggests, the selection of supplements on a basis of the cost of a pound of protein they carry has much to recommend it in practice if unknown new supplements are compared with standard supplements of known high value. Results of experimental feeding tests suggest certain deviations from this rule and, as pointed out earlier, the fiber content of feeds may at times have to be considered.

FEEDING THE BREEDING HERD

The character and amount of feed to allow breeding animals depends on their age and condition and the object for which they are being fed. Adjustment of the protein and fiber content of the ration to meet the needs of the animals usually results in a suitable proportion of the other nutrients. Some variation in the amount of both protein and fiber in the ration is entirely consistent with good results. The amounts shown in Table 3 have been fed successfully and can be used safely as guides.

Variations from the suggested amounts of feed may be necessary in order to keep the animals in the desired condition. This is a matter that only the feeder who is observing the animals daily can decide. If good pasture is available, somewhat less feed than the amounts shown in the table should be required.

TABLE 3.—COMPOSITION OF SUITABLE RATIONS FOR BREEDING ANIMALS¹

	Protein not less than	Fiber not more than	Total feed per day per cwt.
	<i>perct.</i>	<i>perct.</i>	<i>lbs.</i>
Pregnant sows.....	10-12	11	1.0-1.4
Pregnant gilts.....	12-14	10	1.2-1.5
Sows and gilts with litters.....	15-16	5	3.0-5.0
Young gilts and boars.....	12-14	7	3.0-4.0
Boars during breeding season.....	12-14	5	2.0-4.0
Idle boars.....	10-11	10	1.0-1.3

¹When the pigs are on pasture, the percentage of protein in the remainder of the ration may be reduced by 1 to 2 percent.

Sows that are gaining rapidly for a short time before they are bred are more likely to settle and produce a larger number of pigs than sows that are unthrifty at this time. During the 114 days of gestation the sow should be fed to gain from 80 to 100 pounds in weight. The feeding of a well-balanced ration, which includes pasture when it is

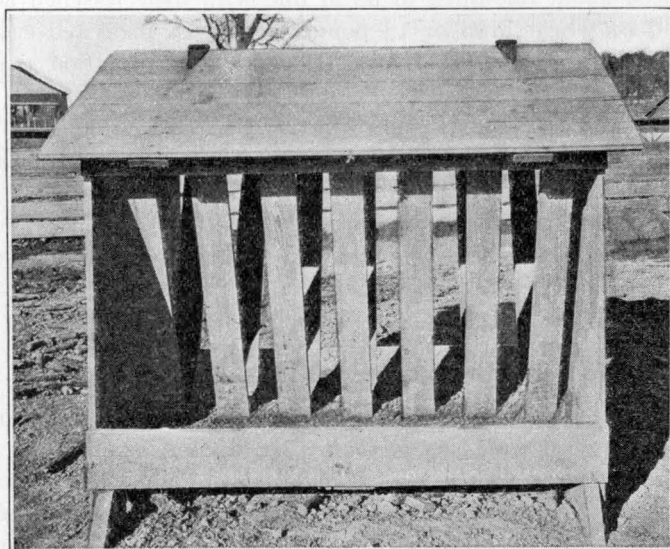


FIG. 1.—FEEDING RACK FOR SOWS

Sows that farrow in the spring frequently “go down in the back” just before or soon after they have weaned their pigs. This trouble can be almost completely prevented by feeding the sows (when pasture is not available) legume hay of good quality in addition to a well-balanced ration. The hay can be fed very successfully in a rack such as this during the gestation period and the suckling period as well.

available and good-quality legume hay at other times, insures strong, vigorous pigs at birth and puts the sow in condition to produce a good flow of milk.

Pregnant Sows Require Special Care

Any of the farm grains can be used as the main part of the ration for pregnant sows. Sufficient protein supplement should be fed to bring the percentage of protein to at least the minimum suggested in Table 3. From $\frac{1}{3}$ to $\frac{1}{2}$ pound of soybeans or $\frac{1}{4}$ pound of tankage per head daily will usually accomplish this. Mature sows fed farm grains may need no additional protein if they have plenty of good pasture. Even under such conditions $\frac{1}{4}$ pound of tankage during the last two months of gestation is usually good insurance for satisfactory milk production. Gilts that are still growing should be allowed protein supplement all thru gestation.

A stalk field is an ideal place in which to run fall-bred sows. Suitable amounts of other feed should be given as the supply of corn in the field becomes low.

Clean water and salt should be available at all times.

If the sows are put in pens to farrow, their feed at that time should be reduced about one-third to be in line with their lessened activity. A pound of wheat bran or $\frac{1}{3}$ pound of linseed meal fed each sow daily will help to overcome any tendency to constipation that may develop while the sows are confined to small pens.

The day the sow is expected to farrow the ration should be further reduced. Ordinarily no feed is needed for 12 to 18 hours after farrowing. Water that is not too cold should be freely allowed.

Greater care and more time are needed to bring a heavy milking sow or one with but a few pigs to full feed than one with a large litter or one that is a naturally poor milker. It can ordinarily be accomplished safely in ten days to two weeks.

Sows With Litters Need Ration Rich in Protein

The object to be sought in feeding sows with litters is to stimulate their milk flow as much as possible. To accomplish this the ration should be palatable, rich in protein, and low in fiber. Because of the beneficial effect they have on milk production and the growth of little pigs, pastures are of primary importance during the suckling period.

The most palatable farm grains and many by-product materials can be used. Oats should be fed sparingly because of their bulk. The grains need not be ground except as a precaution against their passing thru the animals unutilized. This applies primarily to the small grains. Slopping sows, tho very common, is not essential, since

feeds offered dry in a trough or self-feeder and a good water supply will stimulate their milk production just as well.

Protein supplements for farm grains are just as essential to high milk production in the sow as in dairy cows. There has been no direct experimental determination of the protein requirements of milking sows, tho from indirect evidence it is felt that 15 percent protein, as suggested in Table 3, is as low as should be fed. Usually sows will stay in better condition and will wean larger pigs if they are allowed a full feed of good protein supplement in addition to grain than if their protein supply is restricted. The average mature sow, if allowed a full feed of grain and tankage, will eat about a pound of tankage daily during the suckling period. A ration of 1 part tankage to 8 parts corn contains about 15 percent protein.

FEEDING YOUNG PIGS

Good Feeding Begins With Sow

Feeding the new crop of pigs should begin before they are farrowed. The relatively small amount of nutrient material in the pigs at birth (less than 5 pounds for a litter of eight) suggests that the prenatal development of the pigs is not largely dependent on the ration fed the dam, as she could probably take the 3.25 pounds of protein and 1 pound of ash required for the litter from her own body if necessary. (The exercise of the sow, on the other hand, is thought to influence the strength and vigor of the pigs at birth.) The feed the sow gets during gestation is, however, extremely important in putting her in condition to suckle her litter well.

Because pigs gain during the suckling period more cheaply than at any later time, the milk production of the sow has a direct influence on profits. It is likewise important that the pigs have a generous supply of suitable feeds as soon as they show any interest in eating.

Iron Prevents Nutritional Anemia

The mother's milk is popularly supposed to be a rather complete feed for young animals. It is now known, however, that pigs restricted to their mother's milk develop anemia within three to five weeks after birth. This condition is identified by a decline in the number of red cells and the amount of hemoglobin in the blood. Anemic pigs show a paleness of skin (except where this is masked by black pigment) especially about the ears and the end of the nose. In advanced stages of anemia the pigs develop a drawn expression about the forehead and eyes, and a thickened, edematous (watery),

wrinkled condition of skin about the neck and shoulders; they become listless and inactive, a condition that increases the danger of their being mashed; they frequently develop thumps and may ultimately die. Characteristic internal lesions also develop; especially noticeable are paleness of the membranes, greatly enlarged heart, and lesions in the liver.

From a practical standpoint anemia is primarily troublesome in pigs farrowed during cold weather and kept sheltered. The consumption of almost any natural feed, except milk, or the opportunity to root in the soil will apparently prevent anemia developing to a dangerous degree or will even stimulate recovery if the condition has not developed too far. Studies made at the Illinois Station indicate that exercise is not a factor either in protection or cure.

This nutritional type of anemia has been shown definitely to be due to a deficiency of iron in the milk of the sow. Copper may also be involved. Because the malady is due to a shortage of these necessary elements, it is not surprising that the fattest, most growthy pigs may be troubled first, since rapid growth naturally increases the rate at which the blood forming constituents are used in the body of the little pig beyond the meager supply of these elements in the milk.

This milk anemia can be prevented by making it possible for the pigs to get additional iron or iron and copper before they begin eating solid feed. Pigs that have the run of pasture during this time or that have the opportunity to root in the soil apparently do not develop anemia to any marked extent. A simple and cheap, yet effective, method of preventing anemia in pigs not so handled has been worked out at this Station. It consists in applying to the udder of the sow a solution that contains iron and copper. It seems quite evident that under practical conditions the solution need contain only iron. It can be made by dissolving 20 ounces of copperas (ferrous sulfate) in two quarts of water. After the copperas is dissolved, add 2 quarts of any ordinary sirup to make the mixture adhere to the udder. Apply the solution to the udder of the sow once a day with a clean brush during the time the litter remains in the barn or until the pigs begin to eat solid food. The treatment is positive, since the pigs cannot nurse without getting the iron.

In work at this Station death losses among treated pigs were very low, only 1 out of 35 treated pigs having been lost between the ages of eight days and eight weeks; while 24 out of 60 untreated pigs died during this same interval, a loss of 40 percent.

Work at this Station and others indicates definitely that anemia cannot be avoided by feeding the sow the necessary elements.

Pasture, Grain, and Supplement Give Best Start

Pasture is very helpful in giving pigs a better than average start. In addition to the important contribution it makes to their ration by supplying protein, mineral matter, and vitamins the hazard from parasites and infections so dangerous to young pigs is less on pasture than it is in old lots.

Before weaning, when offered a variety of feeds, pigs show a preference for shelled corn. Oat kernels and wheat are also very palatable

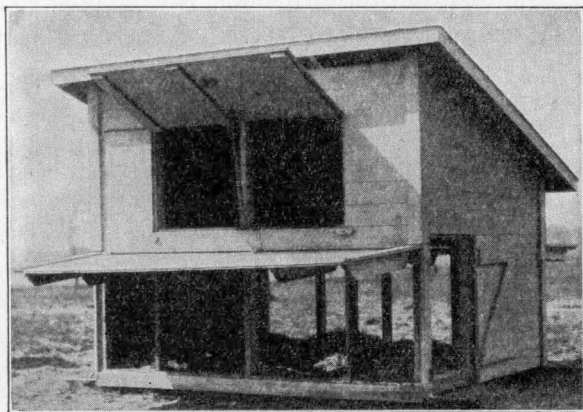


FIG. 2.—A STURDY, WELL-BUILT HOUSE PROVIDED WITH RUNNERS FOR MOVING EASILY

A house of this construction is serviceable as a farrowing pen even in cold weather, yet when it is opened up as shown above, it affords suitable shade for any class of hogs.

to them. Wheat middlings and whole and finely ground oats they eat less readily. The ration for pigs at this time need not be complex for good results. Shelled corn or other palatable farm grain and a good protein supplement offered in a self-feeder in a creep is a simple yet satisfactory way of starting pigs. So long as the pigs are nursing they will not eat a great deal of supplement. With it available, however, they are able to obtain their needed protein as the milk supply declines. By weaning time the pigs have come to depend so much on the self-feeder that they scarcely miss their mothers.

The changes in feed consumption and gain that are characteristic of pigs as they increase in weight are shown by the data in Table 4. The feeding was done in dry lot and the ration consisted of corn and supplement in separate compartments of a self-feeder. The supplement contained tankage, linseed meal, and alfalfa meal in the ratio of

TABLE 4.—SUMMARY OF FEED CONSUMPTION AND GAINS OF PIGS OF DIFFERENT WEIGHTS SELF-FED CORN AND SUPPLEMENT FREE-CHOICE¹
(Weights expressed in pounds)

Number of animals	Average weight	Range in weight	Average daily feed			Protein in ration	Average daily gain	Feed for 100 pounds gain
			Corn	Supplement	Total			
						<i>perct.</i>		
778.....	74	50-100	3.23	.86	4.09	18-15	1.12	365
838.....	124	100-150	5.40	.97	6.37	15-13	1.49	428
685.....	174	150-200	6.85	.73	7.58	13-12	1.69	449

¹For most rapid gains the fiber content of the ration of fattening pigs should not exceed 5 percent.

2:1:1. The amount of corn eaten increased rapidly with an increase in weight. The daily consumption of supplement increased until the pigs reached a weight of 125 pounds and then gradually decreased.

It is interesting to note that pigs lighter than 75 pounds in weight actually ate more protein supplement per head daily than they did when they weighed 150 to 200 pounds. The time of highest daily consumption of supplement was when the pigs weighed between 100 and 130 pounds. Some of the groups of pigs of this weight ate more than a pound of supplement per head per day. The proportion of supplement in the ration decreased rapidly as the pigs became larger; the *total* protein intake, however, increased steadily. The percentage of protein in the ration, on the other hand, decreased from 18 for the 50-pound pigs to 12 in the ration of the 200-pound pigs. Whether this voluntary decrease in the consumption of supplement indicates a progressive decrease in their protein requirements is not known. The change is, however, characteristic of growing-fattening pigs that are fed grain and supplement free-choice.

It is evident from the table that larger pigs gain more rapidly than smaller ones, but that it takes more feed to produce a pound of gain on heavier pigs.

These figures represent the results of allowing a fairly large number of pigs to balance their own rations. While they cannot be taken as an exact statement of the protein requirements of pigs at different weights, they can, in absence of knowledge along this line, be considered as representing the approximate needs of pigs for satisfactory gains. A ration much richer in protein than these average figures suggest will probably be wasteful of protein, which ordinarily would increase the cost, while any wide departure below these values will

reduce the rate of gain and increase the feed required for a unit of gain. The actual costs and profits involved will, of course, depend on the prices of feeds used.

Self-Feeder Simple and Efficient

It is very evident, as pointed out earlier (see page 10), that under most conditions it will pay to feed some good protein supplement with the common farm grains to fattening pigs. Experiments have also demonstrated that with corn, and in large measure with barley, wheat, and similar grains, full-fed pigs can be depended on to select approximately the proper amount of tankage, or other suitable supplements,

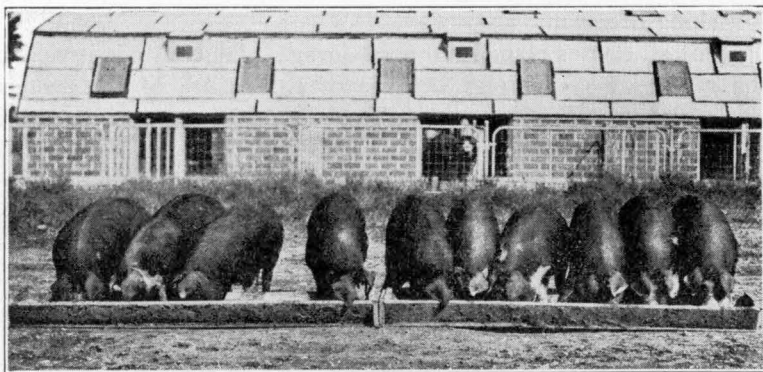


FIG. 3.—MORE THAN A TON OF PORK IN SIX MONTHS

One litter of pigs fed by the simple methods here outlined and kept free from parasites and disease can be developed to a ton of pork in six months.

to balance their ration when the grain and supplement are of good quality and are offered free-choice. Combining this idea with the use of the self-feeder (see page 30) has greatly reduced the labor and trouble of feeding large droves of swine. Shelled or even ear corn or other grain can be put in one self-feeder and the protein supplement in another and the pigs allowed to balance their own ration. One of the advantages of this method is that the same feeds can be used from the time the pigs begin to eat until they are ready for market. The pigs voluntarily change the proportion of the grains and supplement supposedly in accordance with their changing bodily needs, as shown already in Table 4.

The efficiency of this simple method is indicated by records of ton litters being produced by it with as few as nine and ten pigs in a litter. A ration of shelled corn fed free-choice with a tankage-oil-meal supplement on pasture has repeatedly produced pigs that weigh over 200

pounds when they are six months old. Even more rapid and economical gains can be expected from the intelligent use of this simple method of feeding than from the more expensive one of grinding and mixing all the feeds into a complete ration.

FORAGE CROPS HAVE DISTINCT VALUE FOR SWINE

There is nothing that will solve as many of the problems of the pork producer as an abundance of good forage. From the very nature of the case a careful program of swine sanitation can be more effectively followed by the intelligent use of pastures than in any other manner. This in itself is a great contribution to the final profits of a pork-making program.

Pigs of all classes respond to good forage. Especially is it valuable in the ration of young pigs because of the nature of the proteins, minerals, and vitamins it provides them. Mature sows may need little else than good forage during most of the gestation period. Full-fed fattening pigs utilize pasture less extensively than other classes of swine, but its value for them is shown by increased gains and a saving of feed.

The amount of feed saved by pasture depends on the quality of the forage and the character and amount of the rations fed. Good pasture will save from half to all of the protein supplement. All of it will be saved in feeding mature, dry sows and even growing pigs on a light grain ration, and as much as half of it in the case of young pigs and fattening shotes on full feed. Experiments have shown that an acre of good forage will save from 900 to 1,200 pounds of feed in making gain on fattening hogs, a large part of the feed saved being protein supplement.

The carrying capacity of pastures will, of course, vary with the factors that influence the yield and palatability of such crops and the care given the pasture, as well as with the method of feeding the pigs. An acre of good forage properly handled to keep it productive can usually be depended on to carry from 10 to 20 hundredweight of pigs for 120 to 180 days.

It is a common practice to carry even early spring pigs thru the summer on pasture with a minimum of grain and fatten them on new corn. The wisdom of this procedure is doubtful. The difference in the amount of grain required to bring pigs to market weight by this method compared with full feeding them is not great, tho full feeding usually requires less feed owing to the much shorter time the pigs are on feed.

On the other hand, the full-fed pigs will require not more than half the amount of pasture needed by the others. Another factor of importance is that the proportion of runts and the actual death losses are lower among the full-fed pigs. Of greater importance still is the fact that light feeding delays marketing, while the price of hogs early is higher than it is later in the fall. During the last ten years on the Chicago market hogs weighing 200 to 250 pounds have sold for 31 cents to \$3.60 more a hundred in September than they did in December, the average difference being over \$1.92 a hundred. The price of feed (corn primarily) is seldom if ever enough lower after harvest to justify delaying the finishing of the pigs until it is available and then selling the hogs on the lower market.

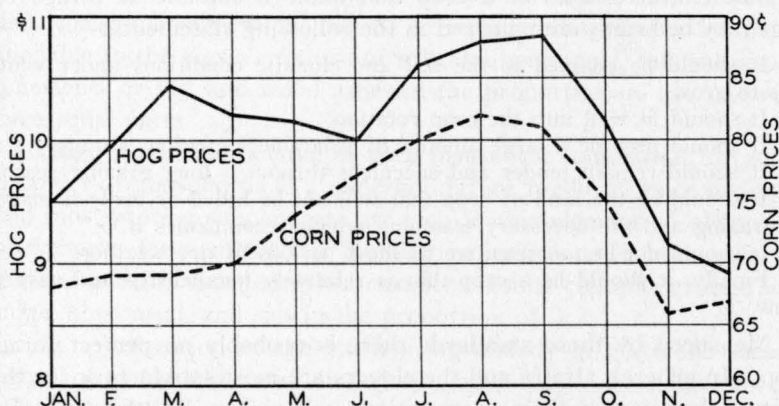


FIG. 4.—SEASONAL TRENDS IN HOG AND CORN PRICES

The above graph shows the average monthly price of 200- to 250-pound hogs on the Chicago market and the farm price of corn in Illinois during the ten-year period 1921-1930. The rapid decline in price of both hogs and corn after September is most noticeable. Every year during this period it was more profitable to full-feed the early spring pigs and market them in September than to feed a light ration during the summer and finish on new corn. The decline in the price of corn has never been sufficient to offset the lowered value of hogs on the later market.

Feeding March pigs a light feed on pasture in order to put on their last 100 pounds of gain with new corn would have saved, during this ten-year period, approximately 75 cents a head owing to differences in market value of feed. In accomplishing this small saving in feed, however, the pigs would have been thrown on the market when they were worth on the average more than \$4 a head less than they would have been in September. The seasonal trend in hog and corn prices is shown in Fig. 4. Hog prices do not usually vary as much during the period of marketing fall pigs as they do when the spring crop is on the

market. It is good practice, however, with fall pigs as with spring pigs, to feed them to gain rapidly and to market them as soon as they are finished.

As implied earlier, pigs on light feed on good pasture are not in great need of more protein than is supplied by the forage and the grain that is fed. Pigs after weaning, full-fed fattening pigs, and sows that are suckling litters need more protein than this and will usually pay well for the addition of a protein supplement to the ration on pasture. One-fourth to one-third of a pound of tankage or its equivalent per head daily for growing fattening pigs will usually be found sufficient. Sows that are suckling large litters require more than double this amount.

The characteristics of a crop that make it suitable as forage for hogs may be briefly summarized in the following statements:

It should be adapted to the soil and climatic conditions under which it is to grow.

It should fit well into the crop rotation.

It should provide a large amount of palatable, nutritious forage.

It should remain tender and succulent thruout a long grazing season.

It should be the kind of crop that will not be killed or badly damaged by grazing and the necessary tramping which accompanies it.

It should not be too sensitive to short periods of dry weather.

Finally, it should be a crop that is relatively inexpensive and easy to grow.

Measured by these standards there is probably no perfect forage crop. In general, alfalfa and the clovers are most satisfactory for this purpose because of their composition, palatability, length of grazing season, and total forage produced. Rape is a close second to these legumes. Most annual legumes are not well adapted to grazing. The grasses and cereals are usually less palatable, provide a shorter grazing season and less total forage, and save less grain than the clovers and alfalfa.

Space will not permit a discussion of the merits of individual crops. An understanding of the requirements of a good forage crop, listed above, will assist in making a wise choice among those available.

MINERAL DEFICIENCIES SHOULD BE SUPPLIED

Mineral elements are essential to life and all natural feeds contain them in varying amounts. On most rations common salt is the only mineral that hogs need regularly. After a pig's salt hunger has once been satisfied, there is no danger in allowing him free access to a trough of salt. With certain rations it is advisable also to provide additional calcium, which is used extensively in bone growth and milk

production, because the grains, which constitute so large a part of swine rations, are relatively poor in this element. On the other hand, many of the protein supplements in most common use are rich in calcium. This is especially true of skim milk, buttermilk, tankage, and fish meal. Enough of either of these to balance the ration from the standpoint of protein will at the same time correct the mineral deficiencies of farm grains except for common salt. Good pasture also makes the feeding of supplemental minerals unnecessary.

Protein supplements from plant sources, however, do not usually contain enough calcium to correct this deficiency of farm grains. Mineral supplements therefore have some value with rations made up entirely of plant materials. Even under such conditions the improvement in the ration is relatively small. Studies have shown that the mineral deficiencies of such rations can be corrected rather simply by making available to the pigs a mixture of salt and bone meal, salt and ground limestone, or salt and wood ashes in the proportion of one to two or even equal parts.

There is no experimental or even theoretical foundation for adding a carrier of phosphorus to a mineral mixture for hogs, since the grains and most protein supplements are rich in this element. Calcium and phosphorus frequently occur together in nature, as in bone meal. A mineral mixture that has given excellent results contains ground limestone, bone meal, and salt in the proportion of 2:2:1.

As a prevention of the hairless pig malady in goiterous areas, 1 ounce of potassium iodid or sodium iodid should be added to each 100 pounds of this mixture for pregnant sows. Better still would be the use of an iodized salt. This simple and cheap mineral will accomplish in practical swine rations all that any mineral can be expected to accomplish.

The appetite of the pig is apparently a reasonably safe guide to the amount of minerals needed. It is therefore unwise to mix the mineral with any part of the ration, for to do so usually results in the consumption of much more mineral than is necessary, at the expense of feed that would produce gain.

OTHER FEEDING PROBLEMS

Preparation of Feeds

Most feeds require little preparation for hogs. Corn may be fed shelled or in the ear; it is not improved materially by grinding. Coarsely grinding or rolling small grains, on the other hand, results in a saving of feed. The extent of the saving to be expected from this

operation depends somewhat on the hardness of the kernel but primarily, it seems, on the method of feeding. In the rapid eating of pigs that are hand-fed in groups a large number of the small, hard kernels escape being broken by the teeth. Such kernels pass thru the body unutilized. Pigs that are accustomed to eating from a self-feeder eat more slowly and masticate their feed more completely than hand-fed pigs do.

Early tests indicated a saving of 15 to 22 percent of the small grains by grinding. Later observations suggest that with self-fed pigs grinding will save little if any feed.

Soaking is a poor substitute for grinding small grains and it does not improve the value of corn or the cracked small grains.

Cooking reduces rather than increases the value of most feeds for swine. Potatoes are an exception to this rule, tests having shown that raw potatoes are worth only about two-thirds as much as cooked potatoes for fattening hogs.

Recently the Ohio Experiment Station¹ has reported excellent results from cooking soybeans. Cooking made them much more palatable and increased their value per pound in the ration of fattening pigs. Whether cooking either of these feeds will actually pay depends of course on the cost of the operation.

"Slopping" pigs is an old practice. Recent tests, however, have failed to justify the practice with fattening pigs, and there is little evidence to indicate that it is a necessary procedure even with brood sows.

Use of Self-Feeders. The self-feeder is a device for automatically keeping a supply of feed constantly before pigs. Its use is therefore limited to animals that are being full-fed, such as fattening hogs, and sows and litters; tho a ration that contains as much as 11 or 12 percent of fiber can safely be self-fed to sows during gestation.

The principal advantage of self-feeders in pork production is the great saving in labor that accompanies their use. If, however, the common farm grains and suitable supplements are made available in separate compartments of the feeder, pigs often "balance" their own ration to better advantage than would be done for them. Pigs also eat more feed when it is constantly available than they do if fed only twice a day. This larger consumption of a better balanced ration results in more rapid and economical gains.

For satisfactory results with the "free-choice" method of feeding, a supply of both the grains and the supplement should be available to

¹"Soybeans and Soybean Oilmeal for Pigs," Ohio Agr. Exp. Sta. Bul. 452, 1930.

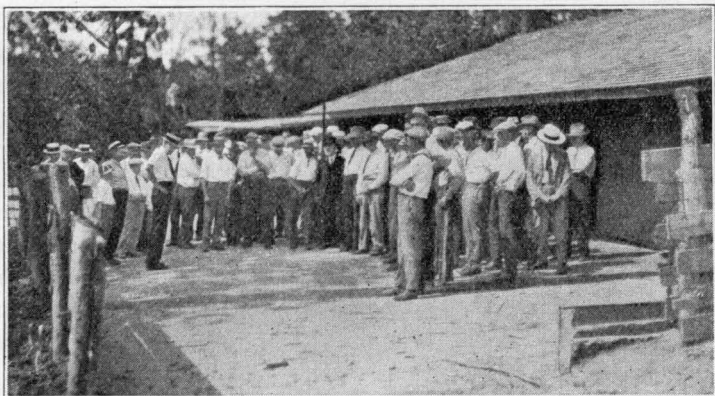


FIG. 5.—A FEEDING FLOOR SAVES FEED AND LABOR

This floor on the farm of A. O. Kunkel of Hancock county has a slope of 1 inch in each 14 inches, a feature that makes it practically self-cleaning.

the pigs at all times, otherwise their gains are reduced because they are forced to eat abnormal amounts of one feed or the other.

Very satisfactory self-feeders can be made on the farm or purchased according to convenience. Certain desirable features should be kept in mind in either case. The material should be durable and

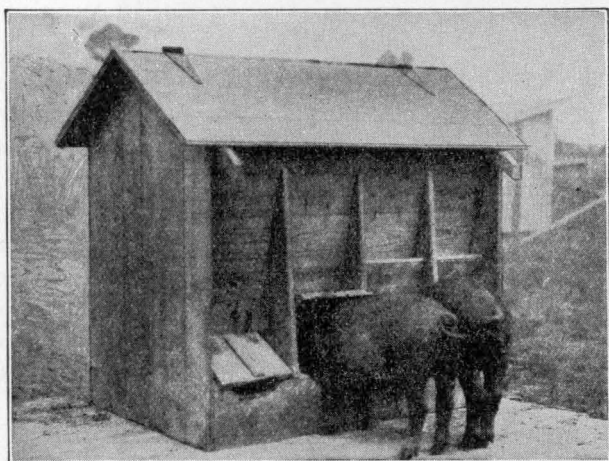


FIG. 6.—A DURABLE AND PRACTICAL TYPE OF SELF-FEEDER

Probably no other piece of hog-lot equipment has contributed so much to the success of pork production as has the self-feeder. Many different types give good results. The chief requirements are that it should be durable and should keep a supply of clean feed constantly before the pigs without waste and without too much attention.

the construction substantial. The feeder should be adjustable, so that it will serve for both whole grains and ground feeds and its capacity should suit the size of the herd in which it is to be used. It should be simple and dependable in operation, that is, it should keep a supply of feed before the pigs at all times without waste and without undue attention. The feeder should protect the feed from weather, rats, and birds, and the trough should be so arranged that there will never be an excessive amount of feed exposed to the pigs at any one time.

The self-feeder is not a substitute for personal attention. It should be visited at least once a day to make certain that it is functioning properly. "The eye of the master fattens his cattle" applies just as truly to the use of self-feeders as to hand-feeding.

The construction and use of self-feeders is discussed more in detail in Circular 319 of this Station, "Construction of Self-Feeders and Their Use in Pork Production."

The Problem of Soft Pork¹

Soft and oily hogs have been known on the American market since the early days when mast-fattened hogs were common. While all the factors responsible for soft carcasses are not known, certain feeds that are rich in oil have been definitely proved to be responsible for some of this trouble. The responsibility of peanuts in this connection is well known and their use in the South accounts in great measure for the discrimination of northern markets against southern hogs.

In recent years the number of soft hogs appearing on corn-belt markets has increased greatly. The rapid expansion of the soybean crop is thought by many to be responsible for this. Undoubtedly soybeans have been a factor, since careful tests have shown that if they are used as the principal source of protein in the ration of fattening pigs, the carcasses produced are soft.

It seems likely that another contributing cause is the popularity of the rangy-type hog. Fat makes up a smaller proportion of the increase in weight of the rangy animal than it does of the animal of thicker type. The rangy animal, therefore, frequently lacks finish when it is marketed, and lack of finish is known to be a factor in soft carcasses.

Soybean oil meal, the residue after the removal of the oil from the beans, is a satisfactory and safe protein supplement to use.

¹For a fuller discussion of this important problem see Bulletin 366 of this Station, "Effect of Soybeans and Soybean Oil Meal on Quality of Pork," and Circular 369 referred to on page 16.

REDUCING COSTS OF CORN HUSKING

By P. E. JOHNSTON

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